Center Independent Research & Development: JPL IRAD

Two-Phase Thermal Control Technology for Small Spacecraft Exploration

Completed Technology Project (2016 - 2018)

Project Introduction

The challenge of this task is to provide an order of magnitude reduction in thermal control power using half the mass while accommodating high heat fluxes and milli-Kelvin stability required for enhanced science.

This task will develop a 2-phase mechanically pumped fluid loop thermal control system for small spacecraft that minimizes system resources, manages spacecraft temperatures, reclaims and redistributes waste heat, and provides science-enabling thermal stability.

Anticipated Benefits

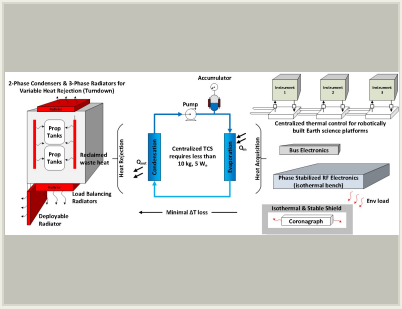
This technology
•Provides order of magnitude reduction in TCS power and 50% reduction in mass over current state-of-the-art.
•Accommodates high heat fluxes up to 5 W/cm^2; isothermalization of < 2 C over a 1-m payload bench; temporal stability of < 0.05 C/minute.
•Modular, scalable, configurable to enable integration and at reduced costs. High degree of control authority results in less thermal vacuum testing time.

The ability to transfer heat over long distances and various interfaces with minimal drop in temperature permits the effective re-use of equipment power dissipations. This permits NASA to consider solar-powered missions to outer planets without the need for excessively large solar arrays.

Commercial communication satellites that deal with powers on the order of 10 kWatts can save upwards of 30% on their flight system mass through this technology.

This technology benefits other government agencies that must manage high heat flux loads, such as those associated with directed energy projects. This technology can be customized to accommodate heat fluxes greater than 500 W/cm^2.

Two-Phase thermal control could apply to: Planetary science missions (Outer planet missions, Venus surface missions, Mars comm relays, Asteroid missions), Earth science missions (High power RF observatories, Hi-res optical), Heliophysics/astrophysics missions (Solar probes, Exo- Planet finders).



Two-phase thermal control concept image.

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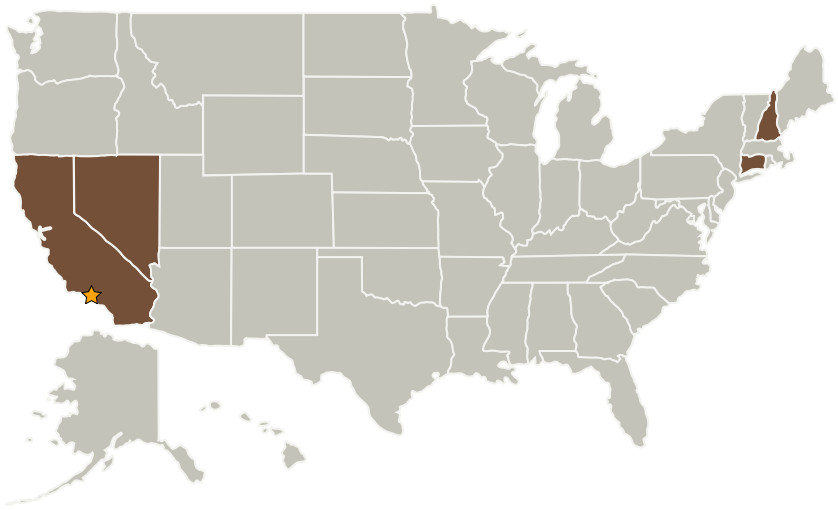
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Co-Funding Partners	Type	Location
Creare LLC	Industry	Hanover, New Hampshire
United Technologies Aerospace Systems	Industry	

Primary U.S. Work Locations	
California	Connecticut
Nevada	New Hampshire

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Center Independent Research & Development: JPL IRAD

Project Management

Program Manager:

Fred Y Hadaegh

Project Manager:

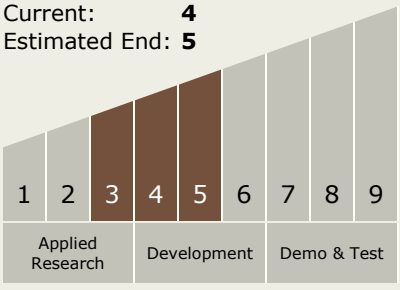
Fred Y Hadaegh

Principal Investigator:

Eric T Sunada

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **5**



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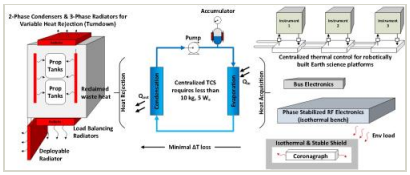
Images



JPL_IRAD_Activities Project Image
Two-phase thermal control concept image.
(https://techport.nasa.gov/image/27938)

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.3 Heat Rejection and Storage

Target Destinations

The Moon, Mars, Others Inside the Solar System

Supported Mission Type

Push